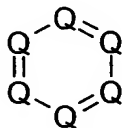


Patent Claims

1. Organic electroluminescent device comprising an anode, a cathode and an emission layer, consisting of at least one matrix material which is doped with at least one phosphorescent emitter, characterised in that a hole-blocking layer which comprises a compound of the formula (1)



(Formula 1)

where the following applies to the symbols and indices used:

- Q is on each occurrence, identically or differently, N or CR, with the proviso that at least two and a maximum of four Q stand for nitrogen;
- R is on each occurrence, identically or differently, H, NO₂, CN, N(R¹)₂, a straight-chain, branched or cyclic alkyl or alkoxy group having 1 to 40 C atoms, in which one or more non-adjacent CH₂ groups may be replaced by -R¹C=CR¹-, -C≡C-, Si(R¹)₂, Ge(R¹)₂, Sn(R¹)₂, -O-, -S- or -NR¹- and in which one or more H atoms may be replaced by F or an aromatic group R¹, or an aromatic or heteroaromatic ring system or an aryloxy or heteroaryloxy group, each having 1 to 40 aromatic C atoms, in which one or more H atoms may be replaced by F, Cl, Br or I or which may be substituted by one or more non-aromatic radicals R; a plurality of substituents R here may define a further mono- or polycyclic, aliphatic or aromatic ring system, or an aromatic or heteroaromatic ring system bonded via a divalent group -Z- or an aryloxy or heteroaryloxy group, each having 1 to 40 aromatic C atoms, in which one or more H atoms may be replaced by F, Cl, Br or I or which may be substituted by one or more non-aromatic radicals R; a plurality of substituents R here may define a further mono- or polycyclic, aliphatic or aromatic ring system;
- R¹ is on each occurrence, identically or differently, H or an aliphatic, aromatic or heteroaromatic hydrocarbon radical having 1 to 20 C atoms, in which a plurality of substituents R¹ or R¹ with R may also define a further mono- or polycyclic, aliphatic or aromatic ring system;
- Z is on each occurrence, identically or differently, a straight-chain, branched or cyclic, preferably conjugated radical having 1 to 40 C atoms, which is preferably in conjugation with the two other substituents, where the number of atoms in Z which link the group of the formula (1) and the aromatic radical is preferably an even number, where one or more non-adjacent C atoms may be re-

placed by -O-, -S- or -NR¹- or one or more C atoms may be substituted by a radical R¹ or halogen;

with the proviso that R does not contain substituted or unsubstituted phenylpyridine, is incorporated between the emission layer and the cathode.

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2. Organic electroluminescent device according to Claim 1, characterised in that a hole-injection layer and/or a hole-transport layer and/or an electron-injection layer and/or an electron-transport layer is present.

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3. Organic electroluminescent device according to Claim 1 and/or 2, characterised in that the hole-blocking layer comprises at least 50% of compounds of the formula (1).

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4. Organic electroluminescent device according to Claim 3, characterised in that the hole-blocking layer consists only of compounds of the formula (1).

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5. Organic electroluminescent device according to one or more of Claims 1 to 4, characterised in that the structures of the formula (1) are selected from the groups of the pyridazines, pyrimidines, pyrazines, 1,2,3-, 1,2,4- or 1,3,5-triazines.

6. Organic electroluminescent device according to Claim 5, characterised in that the structures of the formula (1) are selected from the groups of the 1,2,4-triazines or 1,3,5-triazines.

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7. Organic electroluminescent device according to one or more of Claims 1 to 6, characterised in that the hole-blocking material comprises more than one unit of the formula (1).

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8. Organic electroluminescent device according to one or more of Claims 1 to 7, characterised in that the molecules of the hole-blocking material have a non-planar structure.

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9. Organic electroluminescent device according to Claim 8, characterised in that at least one substituent R in the hole-blocking material contains at least one sp³-hybridised carbon atom.

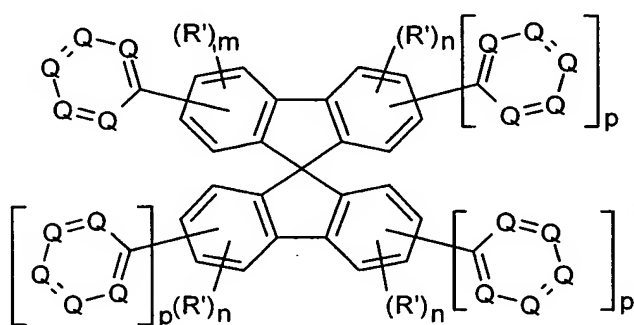
10. Organic electroluminescent device according to Claim 9, characterised in that the sp³-hybridised carbon atom is a quaternary carbon atom.

11. Organic electroluminescent device according to Claim 10, characterised in that in compounds of the formula (1), a 9,9'-spirobifluorene derivative, a 9,9-disubstituted fluorene derivative, a 6,6- and/or 12,12-di- or tetrasubstituted indenofluorene derivative, a tetraarylmethane derivative or a triptycene derivative is present in at least one of the radicals R.
12. Organic electroluminescent device according to Claim 11, characterised in that in compounds of the formula (1), a 9,9'-spirobifluorene derivative is present in at least one of the radicals R.
13. Organic electroluminescent device according to one or more of Claims 1 to 12, characterised in that the glass transition temperature of the compounds of the formula (1) is $> 100^{\circ}\text{C}$.
14. Organic electroluminescent device according to one or more of Claims 1 to 13, characterised in that the layer thickness of the hole-blocking layer is 1 to 50 nm.
15. Organic electroluminescent device according to one or more of Claims 1 to 14, characterised in that the matrix for the phosphorescent emitter is selected from the classes of carbazoles, ketones, imines, phosphine oxides, phosphine sulfides, phosphine selenides, phosphazenes, sulfones, sulfoxides, silanes, polypodal metal complexes or oligophenylenes based on spirobifluorenes.
16. Organic electroluminescent device according to one or more of Claims 1 to 15, characterised in that the phosphorescent emitter is a compound which contains at least one element having an atomic number of greater than 36 and less than 84.
17. Organic electroluminescent device according to Claim 16, characterised in that the phosphorescent emitter contains at least one element selected from the elements molybdenum, tungsten, rhenium, ruthenium, osmium, rhodium, iridium, palladium, platinum, silver, gold and europium.
18. Organic electroluminescent device according to one or more of Claims 1 to 17, characterised in that one or more layers are coated by a sublimation process.
19. Organic electroluminescent device according to one or more of Claims 1 to 17, characterised in that one or more layers are coated by the OVPD (organic vapour phase deposition) process or with the aid of carrier-gas sublimation.

20. Organic electroluminescent device according to one or more of Claims 1 to 17, characterised in that one or more layers are coated by a printing process.

21. Use of the design of the electronic devices according to one or more of Claims 1 to 17 for organic transistors, organic integrated circuits, organic solar cells, organic laser diodes or photoreceptors.

22. Compounds of the formula (2) comprising at least one 9,9'-spirobifluorene unit, characterised in that at least one triazine unit is bonded to the 9,9'-spirobifluorene



Formula (2)

where R and R¹ have the same meaning as defined in Claim 1, and the further symbols and indices have the following meaning:

Q is on each occurrence, identically or differently, N or CR, with the proviso that three Q stand for nitrogen and two Q stand for CR;

R' is on each occurrence, identically or differently, R or F, Cl, Br, I, B(R¹)₂ or B(OR¹)₂;

m is on each occurrence, identically or differently, 0, 1, 2 or 3;

n is on each occurrence, identically or differently, 0, 1, 2, 3 or 4, with the proviso that n must not be 4 if p = 1;

p is on each occurrence, identically or differently, 0 or 1.

23. Compounds according to Claim 22, characterised in that 1,2,4-triazine or 1,3,5-triazine is involved.

24. Compounds according to Claim 22 and/or 23, characterised in that the following applies to the symbols and indices:

R is on each occurrence, identically or differently, an aromatic or heteroaromatic ring system having 1 to 10 aromatic C atoms, which may be substi-

tuted by one or more non-aromatic radicals R, where a plurality of substituents R, both on the same ring and also on different rings, may together in turn define a further mono- or polycyclic, aliphatic or aromatic ring system;

R' is on each occurrence, identically or differently, R, a straight-chain, branched or cyclic alkyl group having 1 to 10 C atoms, in which one or more non-adjacent CH₂ groups may be replaced by -R¹C=CR¹-, -C≡C-, Si(R¹)₂, Ge(R¹)₂, Sn(R¹)₂, -O-, -S- or -NR¹-, or Br, I or B(OR¹)₂;

m is on each occurrence equal to 0;

n is on each occurrence, identically or differently, 0 or 1;

the further symbols and indices are as defined above under formulae (1) and (2).

25. Compounds according to one or more of Claims 22 to 24, characterised in that two triazine units are present, both bonded to the same fluorene sub-unit of the spirobifluorene.

26. Polymers or dendrimers comprising one or more compounds according to one or more of Claims 22 to 25.

27. Use of compounds, polymers or dendrimers according to one or more of Claims 22 to 26 in electronic devices.

28. Electronic device comprising at least one compound, polymer or dendrimer according to one or more of Claims 22 to 26.

29. Electronic device according to Claim 28, characterised in that it is an organic light-emitting diode, an organic solar cell, an organic transistor, an organic integrated circuit, an organic laser diode or an organic photoreceptor.